

File Number **23/36403869M1**

TECHNICAL REPORT

Human exposure

Petitioner's Reference: Servicios de Radio Wavenet

Company Address: Pol. Ind. Requena, N79, 45214 Cedillo del Condado, Toledo

Represented by: Julián Peral Alonso

Equipment: Neso 2.4

Brand: Wavenet PMN: Neso 2.4

Sample #1: 2723/08A Applus Id: 17991-00006

Result: **complies**

It has been tested and complies with the applicable standard. See test result summary section.

Applicable Standard:

EMC standard/s: **FCC 47 CFR Part 2 Subpart J Section 2.1093 (October 2021)¹**
KDB 447498 D01 - General RF Exposure Guidance

¹*The latest modifications of the standard, published at the date of the tests reported in this document, have been considered.*

Dates and Test Site: Applus Barcelona, Bellaterra

Equipment Reception Date September 25, 2023

Test Initial Date: October 9, 2023

Test Final Date: October 9, 2023

Modification Description: M1

This report replaces and supersedes the report 23/36403869 dated on October 31, 2023.

Modification performed: Included explicit reference to PMN, HVIN and FVIN numbers. The antenna gains in table 2 and table 7 is modified according to the customer's specification. The EIRP value and Power Density at 20 cm is updated in table 7 and table 8. Pages 1, 3 and 9 are affected. In addition, general information updated. It is responsibility of the petitioner to replace the previous version with this one.

Test Manager: Alejandro Sáez

Date of issue: Bellaterra, December 12, 2023

EMC & Wireless Technical Manager
Electrical and Electronics
LGAI Technological Center S.A.

The results refer only and exclusively to the sample, product or material delivered for testing, and tested under conditions stipulated in this document. The equipment has been tested under conditions stipulated by standard(s) quoted in this document.

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Service Quality Assurance

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2 GENERAL DESCRIPTION OF TEST ITEMS

2.1 EQUIPMENT DESCRIPTION

This information has been provided by the customer and it is not covered by the accreditation. LGAI does not assume any responsibility from it.

EQUIPMENT DESCRIPTION								
Description	IEM/IFB TRANSMITTER							
EUT Version	FVIN				HVIN			
	2.3.1.0A				5.0A			
Power supply	AC		1 PH + N		90 – 240 VAC		50-60 Hz	
Modulation	GFSK							
Channel list	Channel	Freq [MHz]	Channel	Freq [MHz]	Channel	Freq [MHz]	Channel	Freq [MHz]
	37	2402	9	2422	18	2442	28	2462
	0	2404	10	2424	19	2444	29	2464
	1	2406	38	2426	20	2446	30	2466
	2	2408	11	2428	21	2448	31	2468
	3	2410	12	2430	22	2450	32	2470
	4	2412	13	2432	23	2452	33	2472
	5	2414	14	2434	24	2454	34	2474
	6	2416	15	2436	25	2456	35	2476
	7	2418	16	2438	26	2458	36	2478
	8	2420	17	2440	27	2460	39	2480
Equipment Type	DTS							

Table 1: Equipment description

RF FEATURES	
Radio chipset	NORDIC 24L01
Brand	Wavenet
Module model	NESO 2.4
Peak gain antenna	2.3 dBi
FCC ID	2BC55NESO24-23
ISED ID	31435-NESO24-23

Table 2: RF Features

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2.2 TEST CONFIGURATION

TEST CONFIGURATION		
Power Supply	120 VAC, 60 Hz	
Set-up	Description	Orientation
	The EUT horizontally, as it is intended to be placed in normal operation.	
Normal test temperatures	15 °C to 35 °C	
Equipment Type	DTS	
Test exercise	For measurements tests the EUT is configured at maximum RF output power with continuous modulated transmission, DC < 98% constant according to the customer.	
Test Modes	Channel	Frequency [MHz]
	37	2402
	17	2440
	39	2480

Table 3. Test Configuration

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2.2.1 Samples

Sample #1	
	
Front View	Rear View
	
EUT Power Supply	EUT Communication cable
	<p>Applus⁺ laboratories</p> <p>ID Submuestra: 17991-00006</p> <p></p> <hr/> <p>Cliente: SERVICIOS DE RADIO WAVENET, S.L. Código Oferta: YT-2301242AG-1 Fecha Recepción: 25-09-2023 Marca Muestra: Servicios de Radio Wavenet Modelo: NESO 2.4 Nº de Serie: DUT A</p>
Applus Audio Cable	Applus ID Label

Table 4: Sample #1 description

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2.2.2 Auxiliary Equipment

Auxiliary Equipment				
Auxiliary Equipment 1		Auxiliary Equipment 2		
Auxiliary Equipment 3		Auxiliary Equipment Power Supply		
Description	Port #	Name	Type	Comments
	0	Auxiliary equipment 1	Radio communicator	Provided by customer
	1	Auxiliary equipment 2	Radio communicator	Provided by customer
	2	Auxiliary equipment 3	Radio communicator	Provided by customer
	3	Charger	Power Supply	Provided by customer

Table 5: Auxiliary equipment #1 description

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2.2.3 DUT Modifications performed

No modifications have been performed.

2.3 DUT TEST MODES

DUT Operation Modes														
Mode #	Description		Set-up											
1	The equipment is configured with a test software in order to select the channels required by the standard. The customer provides 3 auxiliary equipment to perform this configuration:		Table top											
	<table border="1"><thead><tr><th>Name</th><th>Channel</th><th>Operation Frequency [MHz]</th></tr></thead><tbody><tr><td>Auxiliary Equipment 1</td><td>Low</td><td>2402</td></tr><tr><td>Auxiliary Equipment 2</td><td>Middle</td><td>2440</td></tr><tr><td>Auxiliary Equipment 3</td><td>High</td><td>2480</td></tr></tbody></table>			Name	Channel	Operation Frequency [MHz]	Auxiliary Equipment 1	Low	2402	Auxiliary Equipment 2	Middle	2440	Auxiliary Equipment 3	High
Name	Channel	Operation Frequency [MHz]												
Auxiliary Equipment 1	Low	2402												
Auxiliary Equipment 2	Middle	2440												
Auxiliary Equipment 3	High	2480												
By means of the EUT Communication cable (RS-232), the auxiliary equipment is connected to the sample to configure its frequency.														
The audio input is terminated with 180 ohm by a cable provided by applus.														

2.4 CONTROL AND MONITORING

According to customer specifications, the EUT start up procedure is as follows:

1. Connect the EUT power supply cable.
2. Connect the RS-232 cable to the auxiliary equipment.
3. Connect the audio cable
4. Switch on the EUT
5. Connect the power cable of the auxiliary equipment.

Once the setup is set up, a receiver is used to verify that the channel configured is the one required.

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3 TEST RESULTS

3.1 HUMAN EXPOSURES STANDARDS

3.1.1 Test Parameters

According to the standard FCC 47 CFR Part 2 Subpart J KDB 447498 D01.

3.1.1.1 Requirements

For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b) of this part, except for portable devices as defined in § 2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in § 2.1093.

Frequency Range [MHz]	Electric field strength [V/m]	Magnetic field strength [A/m]	Power density [mW/cm ²]	Avering time [minutes]
Limits for Occupational / Controlled Exposure				
0.3 – 3.0	614	1.63	*(100)	≤6
3.0 - 30	1842/f	4.89/f	*(900/f ²)	<6
30 - 300	61.4	0.163	1.0	<6
300 - 1500	-	-	f/300	<6
1500 - 100000	-	-	5	<6
Limits for Occupational / Controlled Exposure				
0.3 – 1.34	614	1.63	*(100)	<30
1.34 - 30	824/f	2.19/f	*(180/f ²)	<30
30 - 300	27.5	0.073	0.2	<30
300 - 1500	-	-	f/1500	<30
1500 - 100000	-	-	1.0	<30

Table 6: Requirements – Human exposure

f=frequency

*=Plane-wave equivalent power density

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3.1.2 Test Results

For the evaluation of the RF exposure, the maximum conducted output power is obtained from the following test reports: 2336403866.

Channel	Central Frequency [MHz]	Peak Power [dBm]	Antenna Gain [dBi]	E.I.R.P [dBm]
37	2402	8.6	2.3	10.9
17	2440	8.1	2.3	10.4
39	2480	7.5	2.3	9.7

Table 7: Test results - Human exposure

Therefore, through the following equation, is computed the power density at each frequency transmitted band for a minimum distance of 20 cm between the DUT and the person to comply with the power density limit.

$$S = \frac{EIRP}{4 * \pi * d^2}$$

Where:

S = Power density (mW/cm²)

EIRP = Radiated output power of an isotropic antenna (mW)

d = Distance to the center of radiation of the antenna (cm). Limit for MPE = 20 cm.

According to Radiofrequency radiation exposure limits of FCC Part 1 Section §1.1310 paragraph (e), the maximum permissible exposure (MPE) for 1500 MHz - 100000 MHz, which the DUT is operating is:

Channel	Central Frequency [MHz]	Power Density at 20 cm [mW/cm ²]	Power Density Limits [mW/cm ²]	Result
37	2402	0,002	1	PASS
17	2440	0,002	1	PASS
39	2480	0,002	1	PASS

Table 8: Test results - Human exposure

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